EU CAP NETWORK FOCUS GROUP RECOVERY OF ABANDONED AGRICULTURAL LANDS

Sustainable land management as a lever to land abandonment

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Introduction

The United Nations defines sustainable land management (SLM) as "*the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions*".

SLM includes approaches such as soil and water conservation, natural resource management and integrated landscape management (ILM). Furthermore, it involves a holistic approach to achieving productive and healthy ecosystems by integrating social, economic, physical, and biological needs and values, and contributes to sustainable and rural development.

SLM is based on four principles:

- targeted policy and institutional support, including the development of incentive mechanisms for SLM adoption and income generation at the local level;
- land-user-driven and participatory approaches;
- integrated use of natural resources on farms and at the ecosystem scale; and
- multilevel, multistakeholder involvement and partnerships at all levels – land users, technical experts and policy-makers.

This mini-paper focuses on the above four principles and strives to provide an ecosystem based approach to land abandonment of agricultural lands by pointing out some good examples that factually demonstrate that land users and all stakeholders alike would remain to their lands if soil health would improve, crop productivity would be maintained or even increased, environmental quality would be sustained and income level would be satisfactory to fulfil the farmer's and land user's needs. SLM has these potentials.

Dissertation

1. Major ecological and pedoclimatic regions of Europe and their relevance with land abandonment

The European continent is characterised by a great diversity of climate regimes and soil types. According to Köppen-Geiger classification (Beck et al., 2018) there are at least eight distinct climates in Europe. These include **semiarid, Mediterranean, humid subtropical, marine, humid continental, subarctic, tundra and highland climates**. Each of them has its own distinct characteristics and they impact soil formation, properties, and overall soil health which in turn is reflected in biomass production, as the primary source of food and feed supply. It is evident that rainfall and temperature patterns play a major role in land cover distribution, agriculture land use and crop productivity. In a simple word, while northern regions of Europe are overall

much wetter and colder and covered with an extensive forest and peatland area, the southern part of the continent is heavily affected by droughts, aridity, and overall water scarcity. These last climatic factors are also important drivers of land abandonment.

In terms of soil types and their distribution, the Soil Atlas of Europe published in 2005 by the European Commission's Joint Research Centre (EC-JRC) at Ispra in Italy provides the most comprehensive soil map of Europe (Fig. 1).

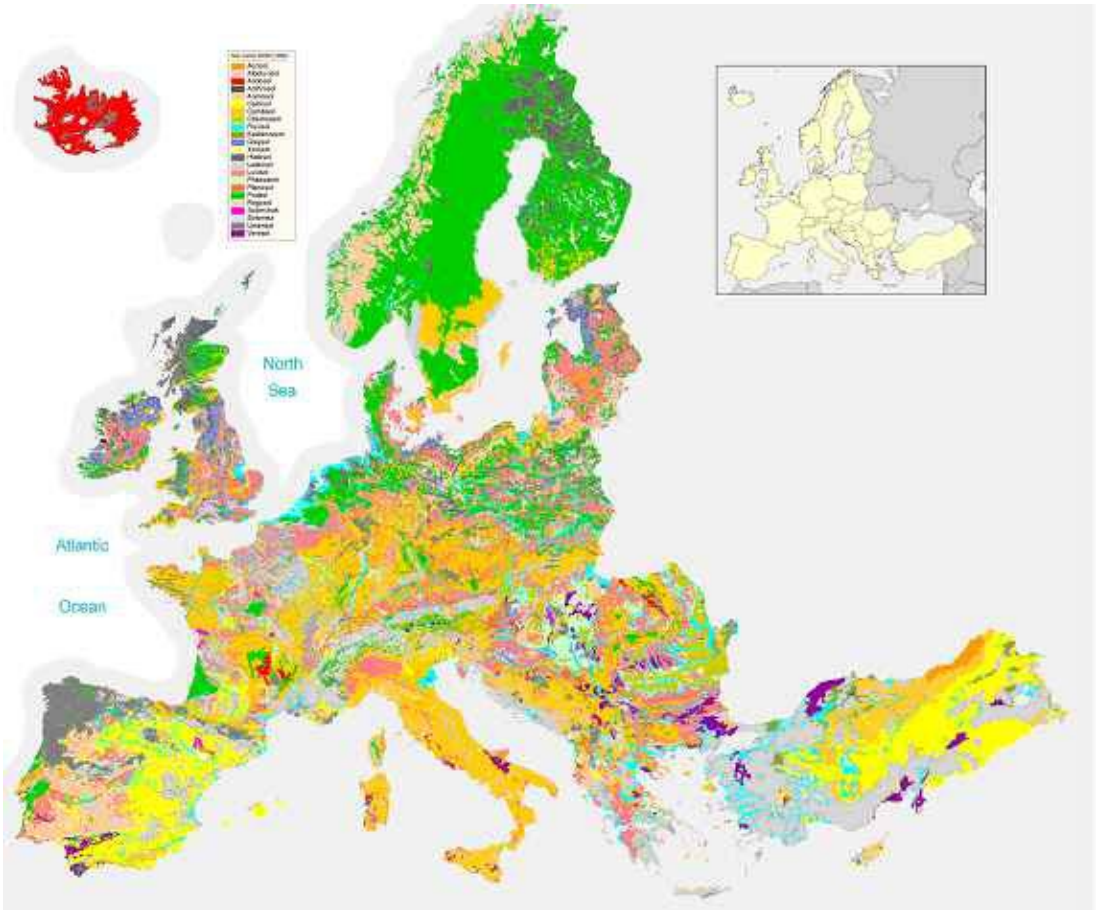

Figure 1. Soil types of Europe according to the World Reference base for Soil Resources (WRB classification, IUSS, 2922). https://esdac.jrc.ec.europa.eu/content/soil-atlas-europe

The main conclusion of the Atlas is that soil resources of Europe are limited and need to be protected for future generations. Several threats are affecting their sustainable functioning not only for the purpose of agricultural production, but also for other important environmental services that soils deliver (see section 2.2). The Atlas is also an important source of information to locate the areas that are more vulnerable or prone to land abandonment. They mostly include saline affected soils like Solonchaks or alkaline affected soils like the Solonetz, as well as acid or shallow (Leptosols) where opportunities for farming are more difficult. On the other side, it is very unlikely that highly fertile and productive soils like Chernozems that have high amounts of soil organic matter are to be the first to be abandoned. Nevertheless, even areas with more fertile soils are subject to other processes such as regional depopulation (e.g. in remote areas), restrictions in cultivation possibilities (e.g. mountain areas) or the proximity of

large urban agglomerations (peri-urban areas) that can also determine the abandonment of these types of agricultural soils.

2. Soil ecosystem services and nature-based solutions

Soil offers numerous functions and services that include storage, filtering, and transformation of various substances crucially important for the existence of life on Earth such as water, Nitrogen and Carbon (Fig. 2). However, only about 1 per cent of the soil microorganisms (bacteria and fungi) have been identified (Wall et al., 2001), and as many as 99 per cent of all soil organisms are yet to be recognised (Alain and Querellou, 2009), no matter the important role they play as indicators of both soil health and crop productivity.

The Millennium Ecosystem Assessment (MA, 2005) considered soil to be an important component of the **ecosystem**, but it is typically the reduction of *supporting ecosystem services* that ultimately lead to the persistent decrease in the ability to provide *provisioning* and *regulating services*. *Supporting services* include soil functions of crucial importance such as primary production for terrestrial vegetation, soil formation, rock weathering, nutrient cycling, and release of nutrients. It is widely recognised that nutrient cycling is the largest contributor of goods and services providing annually about 51 per cent of the total value (US$33 trillion) of all ecosystem services (FAO, 2011). Soil *provisioning services* offer habitat for biodiversity, storing as much as 7,750 tonnes (Mg) H_2O per ha^{-1}, supply food, biomaterials (timber, fibre, and biofuel), raw materials, foundation for building, infrastructure, renewable energy production, and medical/pharmaceutical by-products.

As for the *regulating services*, soil filters and buffers water, regulates hydrological flows, stabilises gas circulation (CO_2/O_2 balance, Ozone (O_3) for ultraviolet UV protection and sulphur oxides (SOx) levels), regulates global climate (temperature and precipitation) through greenhouse gas (GHG) absorption and by soil retention on hillslopes provides erosion control. Finally, soil provides *cultural services* for science development (archive of knowledge about palaeoclimate and palaeoecology), recreation, cognitive and preservation of archaeological heritage (Haygarth and Ritz, 2009). All the above services have direct impact on the people's lives as they involve

> "*Life on earth depends on healthy soils. Soil is the foundation of our food systems. It provides clean water and habitats for biodiversity while contributing to climate resilience. It supports our cultural heritage and landscapes and is the basis of our economy and prosperity*". **EU Mission. A Soil Deal for Europe.**

a range of services that are vitally essential including health, nutrition, income, basic materials, good social relations, and finally environmental security (Dominati et al., 2010). Soils constitute the foundation for agricultural development, essential ecosystem functions and food security and hence are key to sustaining life on Earth (EEA, 2015; EEA, 2023). Healthy soils provide healthy food and better environmental quality and could be levers to reduce land abandonment if they are used sustainably.

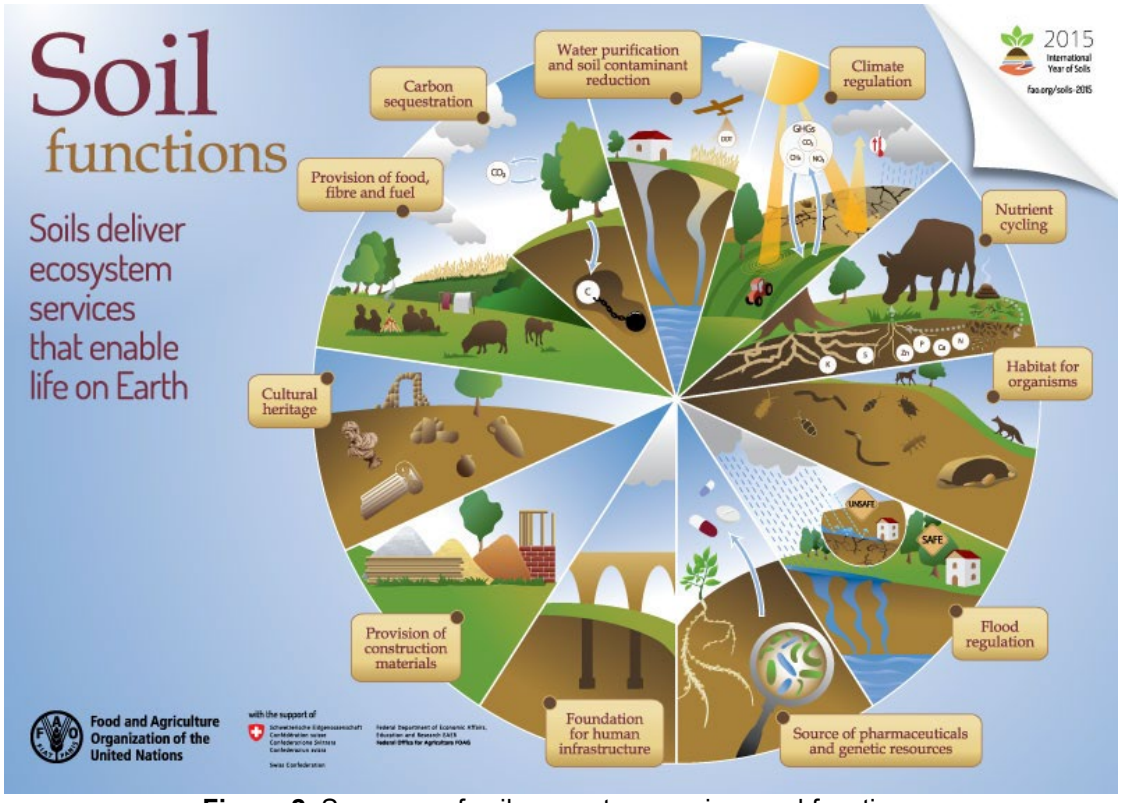

Figure 2. Summary of soil ecosystem services and functions

It is very important to emphasise that soil's ecosystems and its services are fundamental to land abandonment. History has shown that when people destroyed their soils, they destroyed themselves (Diamond, 2005).

The International Union for Conservation of Nature defines nature-based solutions (NbS) as: "*actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits. They are underpinned by benefits that flow from healthy ecosystems and target major challenges like climate change, disaster risk reduction, food and water security, health and are critical to economic development*".

NbS encompasses a broad spectrum of ecosystem-based approaches that hold the potential to address the inter-linked multifaceted environmental crises and broader societal challenges affecting humanity. 'NbS for adaptation' focus on building resilience to the impacts of a changing climate, including drought, floods and extreme weather events. Another term for NbS for adaptation is ecosystem-based adaptation (EbA), which entails the conservation, sustainable management, and restoration of ecosystems as part of an overall strategy to help people adapt to climate change. Nature based solutions offer practical examples that are described in this minipaper to lower land abandonment trends.

Sustainable soil management is an essential prerequisite for the long-term sustainability and viability of farming. However, even sustainably managed, land and soils are not protected against land abandonment if farmers cannot make a living from

it. This important need for sufficient income generation is also considered by the European Commission (EC) in its Farm to Fork strategy, emphasizing that "*Ensuring a sustainable livelihood for primary producers, who still lag behind in terms of income (the average EU farmer currently earns around half of the average worker in the economy as a whole), is essential for the success of the recovery and the transition.*" (EC, 2020). Therefore, in order to reduce the risk of land abandonment on soil that is already sustainably managed (e.g. extensive mountain meadows) the outcomes (biodiversity, landscape, clean air and water, soil carbon sequestration, etc.) of this management efforts need to become an additional income pillar next to the food produced on this area. Right now, 40 to 50 per cent of the income of an average mountain farmer in Austria for example originate from the Common Agricultural Policy (CAP) compensations (BML, 2022). Consequently, a significant share of the income of farmers in mountain areas and other areas facing production constraints consist of payments for income foregone and additional cost in fulfilling the requirements of the CAP measures they subscribed for. However, CAP evaluations show that due to calculation constraints, CAP payments are only to a certain extend economically attractive. Especially payments for "dark green" measures like nature conservation schemes that are highly demanded by society are right now economically not attractive for farmers compared to what they expect (Birdlife Österreich, 2019). Therefore, these measures only offer limited prevention against land abandonment. Other ways, concepts or even markets need to be found so that farmers get paid for the products they produce and services they offer in addition to food products as society demands farmers to deliver. Society cannot take for granted the maintenance of biodiversity, the contribution towards disaster control, the preservation of structured landscape, etc., especially in remote/mountain areas where most of those services are provided under harsh conditions and intensive physical labor input.

3. Best management practices (BMP): examples that could lessen land abandonment

The best management agricultural practices have a direct impact on ecosystems and natural resources (Liniger, et al., 2008, Schwilch et al., 2011, Schwilch et al., 2012, WOCAT, 2016). They can steadily increase farmer's income and agriculture's resilience to climate change. Figure 3 provides a summary of BMP regarding sustainable soil management. If those practices were to be implemented correctly, they would have a very positive impact not only on soil health but also on farmer's income.

Soil carbon sequestration and carbon farming could also act as levers to lessen land abandonment. The capacity of a soil to perform ecosystem functions and provide ecosystem services, depends on key determinants of soil quality (Lal, 2012). In this context, soil organic matter (SOM) is a key constituent, which strongly impacts soil quality because of its positive effects on soil's physical, chemical and biological properties. Indeed, depletion of SOM sets-in-motion a downward spiral with cascading adverse effects, one of which is also land abandonment. A severe and rapid depletion of SOM could also be the result of conversion of natural areas into cultivated lands that rapidly reduce SOM and carbon stocks (Zdruli et al., 2014). Other adverse effects are related to the destruction of soil structure and tilth, along with increased emission of

greenhouse gases (GHGs) into the atmosphere. Based on management practices soils could be both sources and sinks of carbon.

A recent trend that is quickly expanding also in Europe is the so-called carbon farming. The whole process is based on the implementation of SLM that include agriculture practices such as minimum or no tillage, crop rotations, cover crops and use of organic manure and all sorts of organic sources that increase carbon stocks in the soil.
If correctly implemented, it provides farmers additional income and reduce the risks of land abandonment. The EU Carbon Removal Initiative was open for public consultation between February to May 2022. This initiative will propose EU rules on certifying carbon removals[1], and it will develop the necessary rules to monitor, report and verify these removals. The aim is to expand sustainable carbon removals and encourage the use of innovative solutions to capture, recycle and store CO_2 by farmers, foresters, and industries. This represents a necessary and significant step towards integrating carbon removals into EU climate policies.

> Carbon Farming is a new farm approach to optimizing carbon capture on agriculture areas by implementing practices that are known to improve the rate at which CO_2 is removed from the atmosphere and stored in plant material and/or soil organic matter.

Potential BMPs related to SOIL

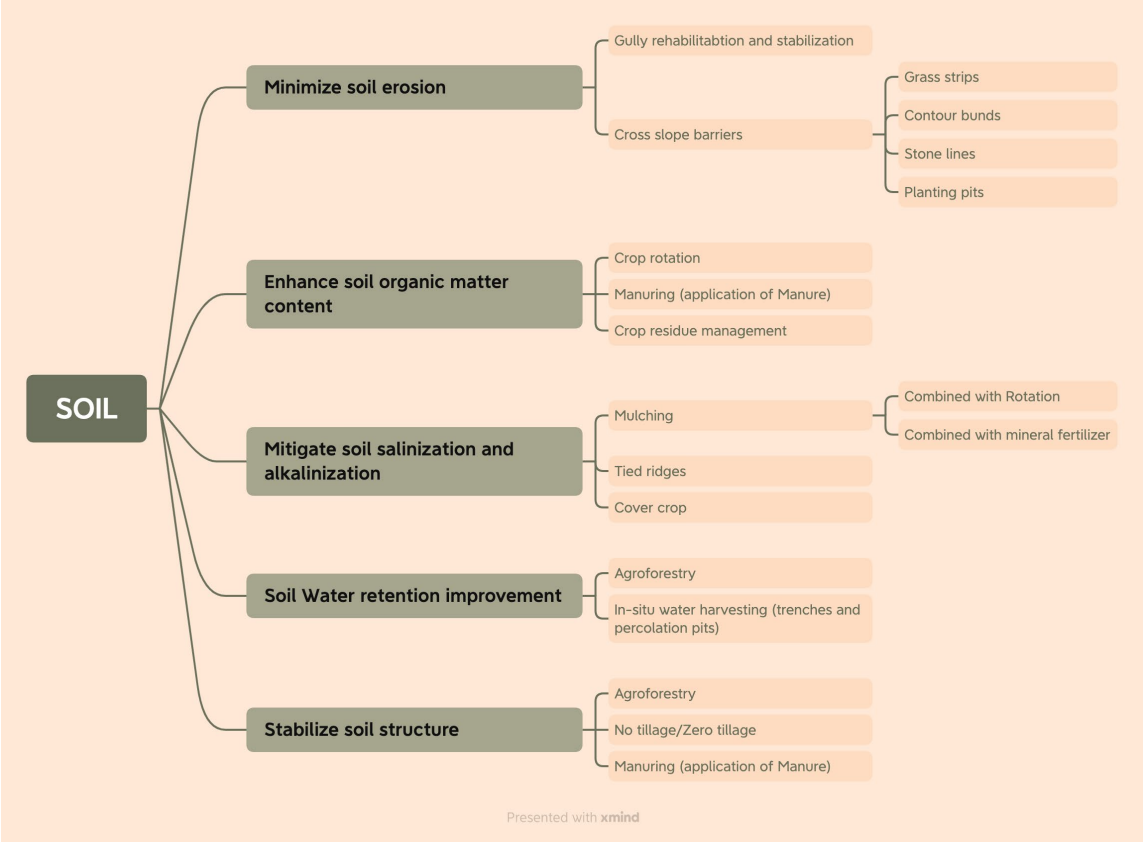

Figure 3. Types of BMPs to improve soil health

[1] There is proposal for a regulation from Nov 2022
Proposal_for_a_Regulation_establishing_a_Union_certification_framework_for_carbon_removals.pdf (europa.eu)

Best management practices from various European countries:

- Terras de Mondalva®, Central Region of Portugal: agroecology and land management

Terras de Mondalva® is a multisector and integrated way to promote the valorisation of the natural heritage and resources by the cultivation of the strawberry tree (*Arbutus unedo*) and recovering the traditional "medronhal", creating an innovative and differentiated rural development model in the hinterland of Central Portugal, highlighting natural elements, endogenous resources, people, tradition juxtaposed to technology and innovation striving to become a Mediterranean agroecosystem reference.

The agroecology practices are consolidated through the specific organic planting of strawberry trees (16ha) as well as by managing natural spontaneous patches of *Arbutus unedo*. This constitutes a novel approach to biodiversity protection conciliated with production of goods and services. It is the first strawberry tree agroecosystem in the world to be certified.

Terras de Mondalva® - innovation in Mediterranean agroecology is an initiative whose components are inseparable from strategic partnerships with public and private institutions as to better integrate not only on its hallmark product – arbutus berry - but all associated products of agroecology origin, as well as the development of concomitant good practices, leading to the elaboration and operationalization of an integrated strategy for appreciation, safeguarding the rural development in the region.

Figure 4. Location of Terras de Mondalva® in Central Portugal (left) and strawberry tree (*Arbutus unedo*) used to recover natural areas (right)

The comprehensive objective is the generation of environmental, social, and economic benefits relating directly to the preservation of biodiversity as well as the enhancement of the territory and the environmental resources via the implementation of biological

agroecology guidelines. The project's implementation areas also aim to diversify a landscape that is otherwise dominated by commercial monoculture forest plantations, promoting expansion of strawberry trees also as fire resilient species.

The practice described has a good impact on erosion control and soil organic matter content into the soil. These are prerequisites for enhancing soil health and reducing land abandonment.

- Ifestio Anemotias S.C.E., Lesvos Island, North Aegean Region, Greece: soil conservation through land stewardship

Up to the 1960's the village of Anemotia, located in the north-western part of the Greek island of Lesvos, comprised of a thriving rural community of approximately 1.200 people. They practiced a traditional Mediterranean farming system predominantly based on subsistence level including the following crops: cereals, legumes, low-input horticulture, as well as olives, figs and grapes, complemented with an extensive presence of livestock (sheep and goat). Viticulture was widespread thanks to the favourable volcanic '*terroir*' (Van Leeuwen and Seguin, 2005) and several grape cultivars like '*Kalloniatiko*', '*Moschato*', '*Mandilaria*', '*Fokiano*' or '*Assyrtiko*' were well adapted to the local conditions. Anemotia was well-known for its table grapes, the red wines and its '*tsipouro'* (a spirit produced from the distillation of grape pomace). The decades that followed saw the replacement of the traditional rainfed viticulture with more profitable tobacco cultivation and gradually, as ageing and depopulation began to take effect, the complete abandonment of the cultivation of those fields that inevitably turned into rangelands. During the last decade, the semi-mountainous village of Anemotia numbered roughly 400 inhabitants and viticulture was practiced mainly for home consumption.

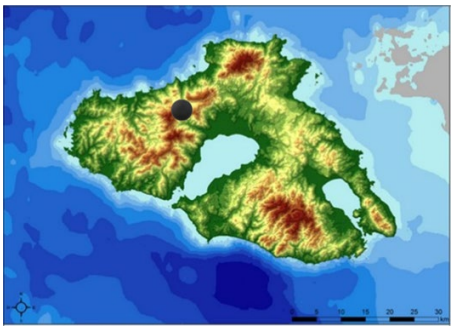

Figure 5. Anemotia village located at the western part of the island of Lesvos- Greece (left) and organic vineyards created by recovering abandoned, severely degraded rangelands (right).

In 2017, Ifestio Anemotias, a Social Cooperative Enterprise (S.C.E.), was founded with the main objective to revive the traditional viticulture at the volcanic caldera of Anemotia and to ensure its sustainable development. Ifestio Anemotias attempts to manage collectively its vineyards, its winery and vine products (four different bottled wines of which one holds a Protected Geographical Indication (PGI) label, vine leaves, *tsipouro* and grape molasses), and to promote wine tourism in the area. Besides, by adopting participatory values and open decision-making processes, this fair profit organisation aims to bring together different stakeholders in search for innovative solutions for strengthening the economic and social viability of viticulture in its area. In 2020, Ifestio Anemotias, in cooperation with the Natural History Museum of the Lesvos Petrified Forest, Anemotia Viticulture Association 'o Kampos' and Skalochori Environmental - Cultural Association 'Dris' initiated a project entitled 'Restoration of degraded soil through its transformation into an organic vineyard for the preservation of indigenous varieties'. This was an 18-month pilot project funded by the Greek Green Fund with a total budget of €50.000. It involved the recovery of 1,5 ha of eroded rangeland and its transformation into an organic vineyard by utilising the traditional local varieties. The land, acquired through voluntary agreements between landowners/users and Ifestio Anemotias S.C.E. (a form of land stewardship), had been cleared and ploughed and the old degraded dry-stone walls (terraces) had been restored. An assessment of the soil qualities and site characteristics and a screening of the local varieties took place with the help of researchers from Ionian University. Planting of phylloxera-resistant rootstock and vine grafting followed. Manure was used

for fertilization and drip irrigation was applied only at early growth stage. Dry stone restoration, planting and grafting were performed by volunteers in a form of experiential workshops aiming to promote participation, networking, and knowledge dissemination. So far, the success of this project -although in a pilot phase - brought again to the public attention the problem of land abandonment and triggered the interest of many absentee owners interested in participating in Ifestio Anemotias S.C.E. future land stewardship programme.

Regeneration of an abandoned vineyard in Ancient Corinth, Greece

In the outskirts of Ancient Corinth, in an area called “Penteskoufi” where an abandoned village with the same name can be also found, the combination of land abandonment and monoculture contribute to the transformation of the ecosystem. While the area teemed with vineyards, olive groves, almond, pear, and apricot orchards in the past, during the last 20 years it has been transformed to a landscape that consists of abandoned land and olive trees.

Figure 6. Abandoned vineyards covered with natural vegetation that has increased soil organic matter

Two local actors, Kontogiannis family and Agroecology lab, teamed up to recover the abandoned land and especially abandoned vineyards. As pioneers of organic farming in the area, Kontogiannis family has contributed to the transition of conventional farmed land into organic and biodynamic. With this experience at hand and almost 25 years of applied organic farming to this specific area of Greece, the team focused to the recovery of abandoned vineyards to bring balance to the local ecosystem, while sustaining indigenous -and undiscovered- grape varieties. Abandoned vineyards may act as “living libraries” of the viticultural heritage of a whole region.

Most of the abandoned vineyards of the area were left untended for the last 20 years, resulting in long vines that were unpruned, and still producing grapes. The observation of the team that is working on the recovery of the abandoned vineyards in the area is that the years of abandonment contributed to the natural regeneration of heavily compacted soils. For example, in a vineyard located in the southern part of Penteskoufi, that was left abandoned for 15 years, the increase of soil organic matter is remarkable. Moreover, the dense layers of natural mulch that were created during those years, contribute to low levels of soil surface and subsurface evaporation, compared to the tilled vineyards of the same area. The soil water holding capacity, along with the mulch, act as a natural protection for soil erosion and allow for high humidity levels, especially during the hot Mediterranean summer.

The goal of this experiment is to prove the resilience of the abandoned vineyards, and in times of climate change to propose ways to vintners, and especially to the younger ones, to trust the quality of the soil along with the high quality of the produced grapes. Abandoned vineyards are characterized by a variety of benefits in terms of soil organic matter content, soil erosion protection and soil structure stabilization, which can play a key role in the European south, and especially the Mediterranean region with long legacy in viticulture. Rural communities should opt for sustaining abandoned vineyards into biodiversity hotspots, by continuing the work that nature has so efficiently done.

- Curtis, Galicia, North-western Spain: Sustainable soil nutrient cycle management

Regarding the agricultural potential for soil carbon sequestration, the use of fertilizing products and soil amendments based on biodegradable materials can keep or increase the carbon stocks in soils and plants. Above all, when organic waste comes from rural actors such as farmers, foresters, small villages, SMEs and agrifood industries, it makes a direct impact. If the carbon and nutrients recovered from those raw materials such as manure, slurry, and organic sources from urban and the agrifood sector are returned to the origin, they help close the nutrient cycle and improve soil fertility. This means that crop fertilization can be more sustainable over time from an economic and environmental point of view, especially in times when the price of inorganic fertilizers jumped up after the war in Ukraine. Besides, these kinds of products can improve soil health, especially in the abandoned land that needs at least a few years to achieve the minimum nutritional crop requirements.

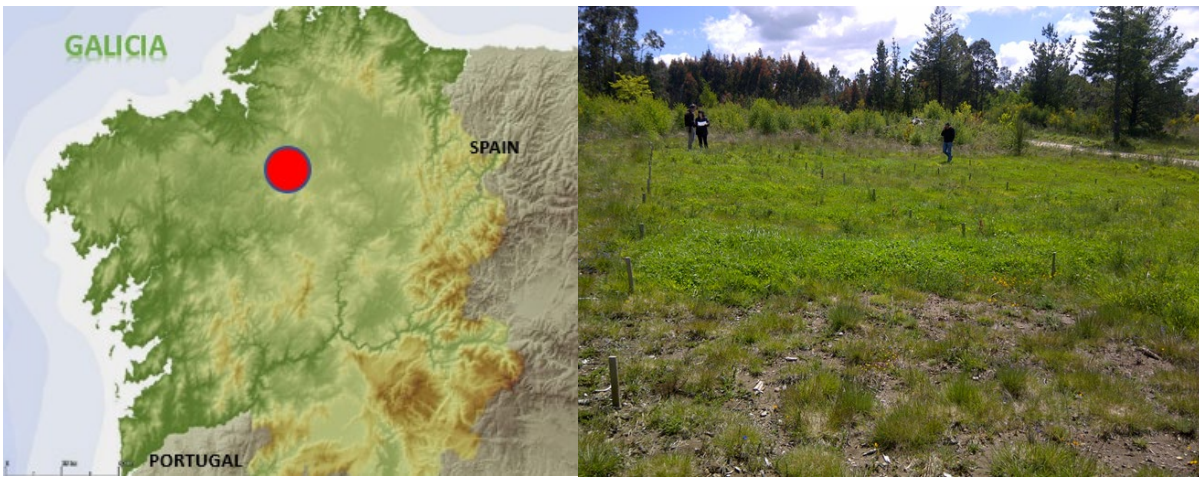

Figure 6. Field trial in Curtis, Galicia (North-western Spain) on grassland recovery by the application of different types of fertilizers and soil amendments.

Since Southern Europe is threatened by droughts and water scarcity, the soil pH is mostly higher, so it would be desirable to use products based on organic waste, such as compost and digestate. The correct application of them would avoid salinization process and help maintaining or increasing soil health to face the droughts and aridity during the dry season.

- Poland: Peatland restoration – win-win solutions for climate protection and sustainable land use

Peatlands are valuable habitats providing many ecosystem services. They have the ability to sequester large amounts of carbon in the soil and biomass, increase water retention, and reduce the run-off of pollutants from agricultural areas into surface waters. They are also important for biodiversity protection. Despite their many functions, peatlands have been under high human pressure for centuries. To date, it is estimated that the total proportion of degraded peatlands in Europe is 25 per cent; while within the EU, it is as much as 50 per cent (or 120,000 km^2). Locally, this percentage is even higher. For example, in Poland it is over 80 per cent and in Germany even 91-100 per cent (Tanneberger et al. 2021; Fig. 7). The degradation of peatlands is primarily due to agriculture, but also forestry or the direct use of peat mining has caused considerable losses (Joosten, Clarke 2002).

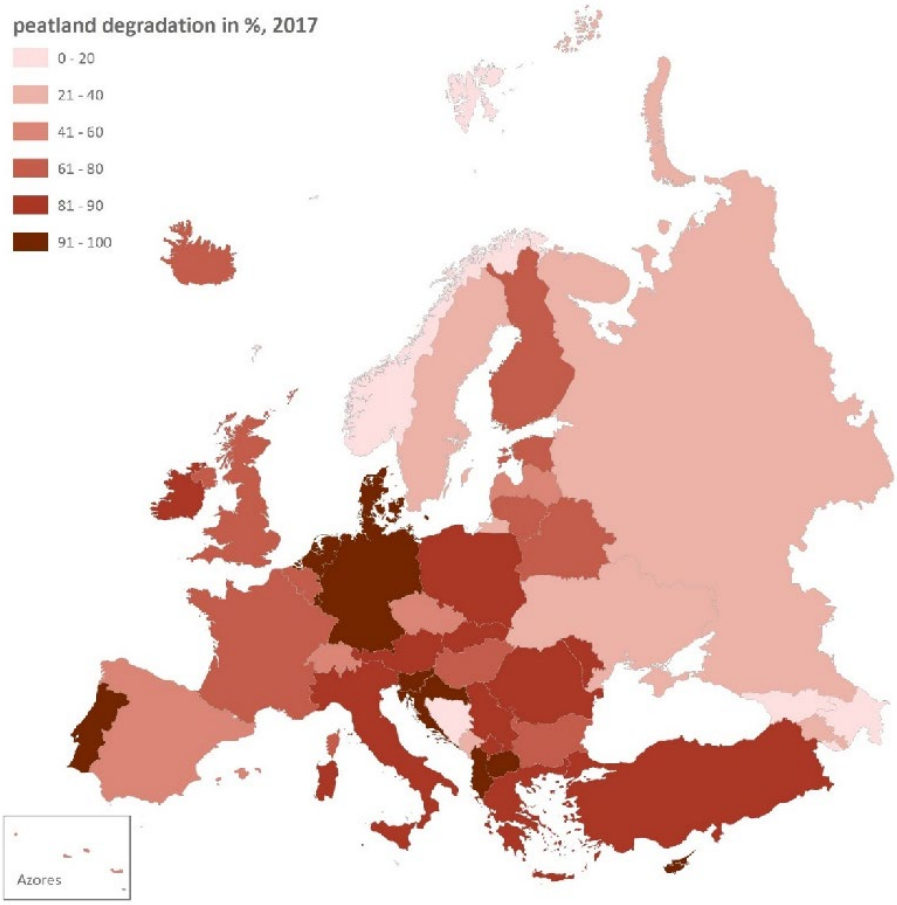

Figure 7 Proportion (in %) of degraded peatlands in Europe per country (Source: Tanneberger et al. 2021).

Drained peatlands cause the release of large quantities of stored carbon in the form of CO^2 combined with even the more potent greenhouse gas like nitrous oxide (N_2O). Therefore, restoring the natural hydration level of peatlands and restoring their organic matter accumulation capacity should be a priority (Greifswald Mire Centre, Wetlands International 2022). It has been estimated that re-wetting just 3 per cent of agricultural land in the EU could reduce greenhouse gas emissions from the agricultural sector by up to 25 per cent (Fig. 8; Greifswald Mire Centre et al 2021). Re-wetting peatlands in the agricultural landscape does not necessarily mean taking them out of agricultural production. Indeed, it is possible to use highly the hydrated land for the cultivation of

specific plant species, while maintaining all the key functions of peatlands. Such sustainable way of using peatlands for economic purposes is called paludiculture (Joosten et al. 2016). Peatlands restoration is, therefore, a nature-based win-win solution for climate and biodiversity protection, and land use. The need of rewetting degraded peatlands most often refers to commercially used (agriculture, forestry, or mining) degraded peatlands. However, it is also applicable to abandoned agricultural land. Agricultural areas that have been created on wetland habitats due to their lower productivity and difficulties for farming are indeed more likely to be abandoned. Regardless of the status of a degraded peatland, such habitats are particularly able to offer many ecosystem services if sustainably managed, therefore should not be abandoned.

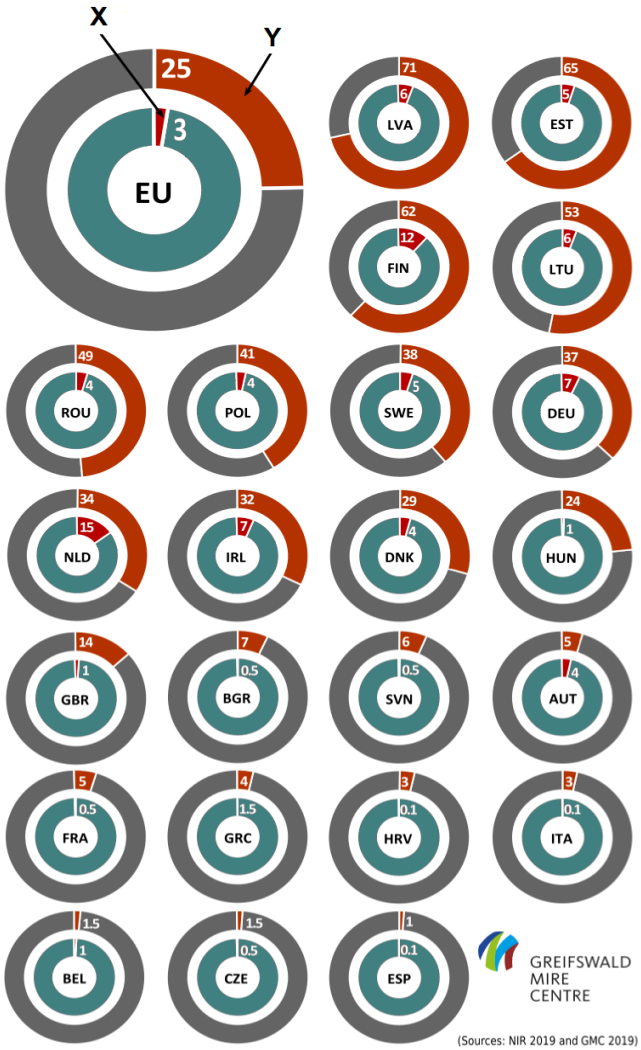

Figure 8. Percentage of agricultural land that needs to be rewetted (inner circle: EU-3%) to reduce agricultural greenhouse gas emissions (outer circle: EU-25%) (Greifswald Mire Center et al 2021).

There are even other good examples of the implementation of paludiculture in Europe. These include traditional crops like reed *Phragmites sp.* or sedges *Carex sp.*, as well as the ones related to the cultivation of cattails *Thypa sp.* or peat mosses, which are currently being developed mainly in Germany and the Netherlands. In Poland, a good

example is the cultivation of reed, traditionally used for roofing and now also for other building materials or pellet production. The scope of such activities is small, but due to the growing demand for this type of material, it has development potential to reduce the process of land abandonment.

The Polish Society for the Protection of Birds (OTOP from Polish Ogólnopolskie Towarzystwo Ochrony Ptaków) has been implementing the protection of the Aquatic Warbler (*Acrocephalus paludicola*), Europe's rarest passerine bird, for more than 20 years in agricultural areas abandoned at the end of the 20th century. The species is associated with sedge-covered alkaline fens, which depend on regular, extensive use – mostly mowing – to maintain their conservation status. As a result of the decline in demand for biomass from such habitats at the end of the 20th century, many of them have been abandoned in Poland. OTOP manage this type of habitat largely thanks to subsidies from the agri-environment-climate scheme targeted at the maintenance of valuable natural habitats and rare bird species. The biggest challenge is the management of the biomass harvested. Currently, the most promising direction is to process it into compost, which can be used as a fertiliser and can successfully replace peat as a substrate for greenhouse or pot plant cultivation.

4. Land use planning and its impacts towards land abandonment

Land use planning and, more broadly, land resources planning (LRP) are needed at different levels of decision-making to promote sustainable and efficient use of resources and to cope with current and future challenges of population growth and increasing demands. Such planning aims for a systematic assessment of land potential and alternatives for optimal land and water use and improved economic and social conditions through participatory processes. These processes involve different sectors and stakeholders and generate multiple benefits and opportunities for local and national economies and private/ public investments.

The main concepts that are essential for a proper understanding of land use planning include factors that determine the use of land and recognize the central role of stakeholders in any planning process. Sustainable planning that takes into consideration also the completing interest in land resources could have direct impacts on use of land or in its abandonment. If a farmer is not assured that his land has further value for farming, he or she will either abandon the land or will wait until its land eventually changes the use from farming to urban or its afforested with considerable economic benefits. That would encourage him even more to abandon the land.

Integrated Land Use Planning (ILUP) thus strives to integrate environmental and socio-cultural/economic data from a variety of stakeholders and users to allocate land in an optimum fashion according to its suitability, while also attending to divergent stakeholder preferences and integrating legal standings, operating on the level of policy, regulation, and zoning (Verburg et al., 2022).

Land use planning could not be successful if it is not well integrated with water management. Therefore, a good combination between land, water, crops, and people is necessary to accomplish sustainable agriculture production and income generation.

Only when these components are addressed correctly farmers are more convinced to continue farming and not abandon their lands.

Conclusions

Some of the most important conclusions of this minipaper draw attention to the prioritisation of the investments in rural areas with a major focus on small scale farming and through wider dissemination of the best management practices and sustainable land management. This could be achieved through the promotion of cost-effective SLM taking advantage of the multifunctional uses of land, that otherwise provide better income opportunities for farmers not to abandon their lands. However, to be able to reach these results it is necessary that farmers have also access to credits, markets and have secured land tenure titles.

Not all the SLM practises could be quickly disseminated and easily implemented. This requires knowledge base and well-informed decision-making documentation and further evaluation of these decisions. Such information should be made available to farmers, land advisors, decision, and policy makers. This also requires the strengthening of the extension services, capacity building and awareness to facilitate the local participation and involvement. Farmers by nature are sceptical to change, but when they see results in their vicinity or to their next-door fellow farmer, they are more propense to change their ordinary practices. It is also for these reasons that the Soil Deal for Europe mission has set the target to establish 100 Living Labs and Lighthouses throughout Europe. If all these best management practices are to be implemented chances are that also land abandonment could be reduced. Lastly, implementation of SLM has much better results when is done at regional scale or at watershed level by combining also the highland and lowland interactions rather than implemented in sporadic places.

Research needs

Embark in new research by bringing together many stakeholders following the concepts of living labs and lighthouses as promoted by the Soil Deal for Europe Mission.

Analyse the impacts of land stewardship and the key assets of SLM for the prevention of land abandonment on different types of land (remote areas, mountain areas, degenerated areas, semi-urban areas, etc.)

Further research is needed to quantify the benefits deriving from biodiversity conservation and how this could lessen the risk of land abandonment. Development of a business model for biodiversity conservation as an additional economic attractive income pillar for farmers is very much needed.

Analyse additional income generating activities for farmers like tourism, nature/landscape preservation, and ecosystem services for the society to reduce the risks of land abandonment.

Analyse the costs of inaction in the prevention of land abandonment.

Based on the Green Deal objectives, identify the mechanisms that have a direct impact on land abandonment and specify the role of sustainable soil management as a remedy to abandonment but also as source of income for farmers who are willing to implement regenerative conservation practices such as minimum tillage, crop rotations, and cover crops.

Ideas for innovation

Development of concepts for a “landscape levy” paid by tourism/recreation facilities and distributed among farmers who provide landscape services as key prerequisite for tourism development in respective regions, especially mountain areas and less favourable areas that are at the higher risk of abandonment

Analyse the potential as well as advantages and disadvantages of landscape maintenance associations (Landschaftspflegeverbände) for the prevention of land abandonment risk and start implementing them in pilot projects.

Develop long-term cooperation models between nature conservation organisations/NGOs and agriculture sector to prevent High Nature Value Farmland from abandonment. Encourage investments from the public and private sector to engage with farmers and local land user so they could remain in those areas.

Implement ecosystem services payment schemes (such as those for clean air, water, and soil) to incentivize farmers not to abandon the land.

Test the success of best management practices in soil recovery of abandoned lands and quantify the income generating benefits for local farmers.

Develop digital technological toolkits and Apps as essential instruments to help farmers take the right decisions both in farming practices as well to reduce the carbon footprint and associated environmental constraints. Complexity of digital farming and making smart use of existing open geo-databases is still missing and embedding this in the various local food systems and networks is still a challenge.

Test different BMP for recovery of abandoned land in different types of soil, analyzing the cost, the timing, the outcomes, etc.

references

Alain, K., and Querellou, J. 2009. Cultivating the uncultured: limits, advances, and future challenges. *Extremophiles* 13, 583–594.

Beck, H., Zimmermann, N., McVicar, T. *et al.* 2018. Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Sci Data* **5**, 180214. https://doi.org/10.1038/sdata.2018.214

Birdlife Österreich. 2019. Evaluierung der Wirkungen von Agrarumweltmaßnahmen anhand von Vogeldaten.

BML. 2022. Grüner Bericht 2022 – Situation der österreichischen Land- und Forstwirtschaft

Dominati, E., Patterson, M., and Mackay, A. 2010. A framework for classifying and quantifying the natural capital and ecosystem services of soils. *Ecological Economics* 69 (2010) 1858–1868

Diamond, J. 2005. Collapse: How societies chose to fail or succeed. Viking Press, USA

EEA, (2015), SOER — Soil thematic briefing, http://www.eea.europa.eu/soer-2015/europe/soil (last accessed February 2023)

EEA, 2023. Soil monitoring in Europe Indicators and thresholds for soil health assessments Luxembourg: Publications Office of the European Union. EEA Report No 08/2022

European Commission, Joint Research Centre. 2015. Soil Atlas of Europe.

European Commission. 2020. A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

FAO, 2011. The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk. Food and Agriculture Organization of the United Nations, Rome Routledge, Taylor and Francis Group, London.

Greifswald Mire Centre, National University of Ireland Galway, Wetlands International European Association 2021. Peatlands in the EU Common Agriculture Policy (CAP) after 2020. Position Paper - (Version 4.8).

Greifswald Mire Centre, Wetlands International European Association 2022. Higher ambition for Peatlands in the EU Nature Restoration Law Proposal. Policy briefing: https://europe.wetlands.org/publications/higher-ambition-for-peatlands-in-the-eu-nature-restoration-law-proposal/

Haygarth, PM., and Ritz K. 2009. The future of soils and land use in the UK: soil systems for the provision of land-based ecosystem services. Land Use Policy 26S: 187-197

IUSS Working Group WRB (2022). "World Reference Base for Soil Resources, 4th edition". IUSS, Vienna

Joosten H., Clarke D. 2002. Wise Use of Mires and Peatlands. Background and principles including a framework for decision-making. International Mire Conservation Group, International Peat Society, 304 ss.

Joosten H., Gaudig G., Tanneberger F., Wichmann S., Wichtmann W. 2016. Paludiculture: Sustainable productive use of wet and rewetted peatlands. [W:] Bonn A., Allott T., Evans M., Joosten H., Stoneman R. (red.). Peatland Restoration and Ecosystem Services: Science, Policy and Practice. Ecological Reviews, Cambridge: Cambridge University Press, ss. 339–357.

Lal, R. 2012. Soils and ecosystem services. In R. Lal, K. Lorenz, R.F. Huttle, B.U. Schneider, and J.Von Braun (Eds) "Ecosystem Services and Carbon Sequestration in the Biosphere". Springer, Holland:11-38.

Liniger, HP., van Lynden, G., Nachtergaele, F., and Schwilch, G. 2008. Questionnaire for Mapping Land Degradation and Sustainable Land Management. CDE/WOCAT, FAO/LADA, ISRIC. Berne, Switzerland, Rome, Wageningen. On-line: http://www.bipindicators.net/LinkClick.aspx?fileticket=WyqJ7nC2%2FWo%3D&tabid=85&mid=795

MA - Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Desertification Synthesis, Island Press, Washington DC, USA.

Schwilch, G., Bestelmeyer B., Bunning S., Critchley W., Herrick J., Kellner K., Liniger HP., Nachtergaele F., Ritsema CJ., Schuster B., Tabo R., van Lynden G., and Winslow M. 2011. Experiences in

Monitoring and Assessment of Sustainable Land Management. *Land Degradation & Development* 22 (2): 214-225. doi 10.1002/ldr.1040.

Schwilch, G., Bachmann, F., Valente, S., Coelho, C., Moreira, J., Laouina, A., Chaker, M., Aderghal, M., Santos, P., and Reed, M. 2012. A structured multi-stakeholder learning process for Sustainable Land Management. Journal of Environmental Management 107:52-63

Tanneberger, F.; Moen, A.; Barthelmes, A.; Lewis, E.; Miles, L.; Sirin, A.; Tegetmeyer, C.; Joosten, H. Mires in Europe – Regional Diversity, Condition and Protection. Diversity 2021, 13, 381. https://doi.org/ 10.3390/d13080381

Wall, DH, Snelgrove, PVR., and Covich, AP. 2001. Conservation priorities for soil sediment invertebrates. In: Soule, E., and Orians, G.H. (eds)., Conservation biology. Research Priorities for the Next Decade. Island Press, Society for Conservation Biology, Washington DC. pp. 99-123

Van Leeuwen C. and Seguin, G. 2005. The concept of terroir in viticulture. Journal of Wine Research, 17:1, 1-10, DOI: 10.1080/09571260600633135

Verburg, P.H., Metternicht, G., Aynekulu, E., Deng, X., Schulze, K., Herrmann, S., Barger, N., Boerger,V., Dosdogru, F., Gichenje, H., Kapović-Solomun, M., Karim, Z., Lal, R., Luise, A., Masuku, B.S., Nairesiae, E., Oettlé, N., Pilon, A., Raja, O., Ravindranath, N.H., Ristić, R. and von Maltitz., G. 2022. *The Contribution of Integrated Land Use Planning and Integrated Landscape Management to Implementing Land Degradation Neutrality: Entry Points and Support Tools*. A Report of the Science-Policy Interface. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany.

Zdruli, P., Calabrese, J., Ladisa, G., Oitekhile, A. 2014. Impacts of land cover change on soil quality of manmade soils cultivated with table grapes in the Apulia Region of south-eastern Italy, *CATENA* Elsevier. DOI: 10.1016/j.catena.2014.04.015